\[ N - \text{number of states} \quad s_0, \ldots, s_{N-1} \]

\[ M - \text{number of symbols} \quad s_0, \ldots, s_{M-1} \]

\[ \text{state}[n][m] \quad q_n \text{ moves if it sees symbol } s_m \]

\[ \text{final}[n] - \text{boolean} \]

```java
public static void main(String[] args) {
    int N, i;
    System.out.println("Please enter # of states");
    N = reader.nextInt();
    int M;

    int[][] state = new int[N][M];
    for (int n = 0; n < N; n++) {
        for (int m = 0; m < M; m++) {
            System.out.println("What state do you get in "+
                    "if you are in state" + n +
                    "and you see symbol" + m);
            state[n][m] = reader.nextInt();
        }
    }
}
```
boolean done = false;
while (!done) {
    int length;
    S.o.p. ask
    int[] word = ...;
    ask ...
    int currentState = 0;
    for (int i = 0; i < length; i++) {
        currentState =
        state[currentState][word[c][i]];
        if (final[currentState]) {
            S.o.p. "Accepted"
        } else {
            S.o.p. "Rejected"
        }
        S.o.p. "Do you want to continue?"
        if (...) {
        }
    }
Pumping lemma.

Let L be a regular language. Then there exists a positive integer p such that for any word w in L with |w| ≥ p, w can be divided into three parts w = xyz such that:

1. |xy| ≤ p
2. |y| > 0
3. For all i ≥ 0, xy^i z ∈ L

Theorem: \(\{a^n b^n : n = 0, 1, 2, \ldots\}\) is not regular.

Proof: by contradiction. Let's assume that L is regular, and let's derive a contradiction from this assumption. Since L is regular, by the pumping lemma there exist an integer p such that every word w from L whose length is ≥ p can be represented as xyz, where len(y) > 0, len(xy) ≤ p, and for all i, xy^i z ∈ L.

Let's take \(w = a^p b^p = \underbrace{a \ldots a}_{p \text{ times}} \underbrace{b \ldots b}_{p \text{ times}}\).

len(xy) ≤ p, \(w = xy^2 z\) starts with a.
So y is in a's, in \(x y y z\) - we add a's but not b's.
We started with a word that has same # of a's and b's, so \(x y y z\) has more a's than b's, so \(x y y z \notin L\). But by pumping lemma \(x y y z \notin L\). We get a contradiction.

So our assumption - that L is regular - is false. Thus, L is not regular.
\[
L = \{ \text{all the words that have the same number of } a \text{ and } b \} = \\
\{1, \text{ab, ba, aabb, abba, abab, ...} \}
\]

\[
L = \left\{ a^{n+1} b^n \right\} = a^{n+1} b^n
\]

\[
\left\{ a^n b^n \right\} \quad \text{and} \quad \left\{ a^n b^{2n} \right\} \quad \text{and} \quad a^p b^p
\]

\[
L = \{ WW \} = \{ \text{catcat, dogdog, bagbag, ...} \}
\]

\[
W = a^p b^p a^p b^p = xyz \quad a \ldots a b \ldots b a \ldots a b
\]

\[
\left( a^p b^p a^p b^p \right) \left( a^p b^p \right) = x y z \quad a \ldots a b \ldots b a \ldots a b
\]

\[
\text{len}(x) \geq p
\]